THE GEOGRAPHICAL DISTRIBUTIONS OF LADYBIRDS IN BRITAIN (1984–1989)

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Few insects are regarded with such general favour as ladybirds. Yet these insects have rarely been submitted to close scientific scrutiny in Britain. Although a Coccinellidae Distribution Mapping Scheme, run by the Natural Environment Research Council Biological Records' Centre, has been in operation for some time, it has not, as yet, published any distribution maps. When it does, the maps will contain all British records, including many over a century old (Muggleton, pers. comm.). Gaining a full appreciation of current distributions from such maps is not always easy. In an attempt to obtain a contemporary view of ladybird distributions in Britain, a nationwide survey of ladybirds was initiated in 1984. The intention of the survey was, and is, to collect information on all aspects of ladybird biology, including their British distributions. The survey was advertised through national and regional press, radio and television, through entomological journals and at entomological exhibitions. Since 1984, we have built up a formidable team of regular ladybird recorders, and have had one or more records from over 7000 people. A diverse range of people have become involved in the survey, from children who have had no formal biological training, to experienced professional entomologists, and with an age range from 3 to 96.

In this paper we present the results of the first 5 years of the survey, outlining some of the suspected biases in the data and the safeguards used to minimize any inaccuracies that may have resulted from the inexperience of some of the recorders.

HOW THE SURVEY HAS BEEN CONDUCTED

In October 1984 an exhibit was displayed at the Amateur Entomologists' Exhibition, on some of the genetical and evolutionary work on ladybirds that M. Majerus had been conducting with colleagues at Cambridge. The last part of the display was a request for information on various aspects of ladybird biology, including their geographical distributions. That request gave rise to the Cambridge Ladybird Survey.

Because of the general dearth of easily available literature on ladybirds in Britain, it was obvious from the outset that we would obtain more valuable information if we gave potential recorders some guidance and feedback. Consequently, we have, over the 5 years of the survey, produced a number of leaflets for recorders. These have included ladybird fact sheets, notes for identification, lists of project ideas and two identification charts with accompanying notes. The first of the charts was illustrated by one of our technicians, Heather Ireland and published by us. The second was illustrated by a professional artist, Sophie Allington, and published by Richmond Publishing. In addition we have produced a Ladybird Newsletter twice a year to keep recorders informed of the survey's progress, and to request data of specific types.

Ladybirds seemed to be amenable as material for a survey to be conducted by persons of a wide range of experience and ability for three principal reasons: (i) they are generally popular, (ii) they are brightly coloured and often rest in exposed positions so that they are easy to find during the day without expensive equipment, (iii) most are easy to identify. It should be pointed out that of the 42 species belonging

to the beetle family Coccinellidae, some are very small (less than 3 mm in length) and are black or brown without bright spotting. Some of these, particularly those belonging to the genera *Nephus* and *Scymnus*, are not easy to identify. Consequently, it was decided that the survey would be confined to the 24 coccinellid species that we, perhaps rather subjectively, decided were 'ladybirds'. The intention was that anyone should be able to take part in the survey. For four pairs of species over which some confusion in identity might still arise, single easily visible diagnostic characters were provided. So, for example the 2-spot ladybird (*Adalia 2-punctata*) and the 10-spot ladybird (*Adalia 10-punctata*) can be separated on leg colour, the former having black and the latter brown legs. It was stressed, from the outset, that if a recorder was in any doubt over the identity of a ladybird they should send it to us, preferably alive. Instructions for sending ladybirds through the post were provided. In the latter part of the survey, an identification key to ladybirds, designed for use in the field by inexperienced recorders, has been available (Majerus & Kearns, 1989).

Throughout the survey we have asked recorders to provide information on host plants, habitats, ladybird behaviour and morph frequencies for variable species, in addition to species, date and location data. The intention was primarily to obtain more information on the habits and ecology of ladybirds. However, this information has also been useful in helping us to pick out possible errors in identification. In any instance in which a report seemed unusual in some particular, the recorder was asked to confirm the record, and if possible to send a specimen. To give two examples; when we received a record of several 'pine ladybirds' (*Exochomus 4-pustulatus*) being found near Manchester, on apple trees in 1985, together with typical 2-spot ladybirds (*Adalia 2-punctata*), I suspected that the 'pine ladybirds' might be the melanic form f. *quadrimaculata*, of the 2-spot. A letter to the recorder, pointing out the difference in shape and spot positioning of the two, bought a specimen and a reply confirming my suspicion. In another case, we suspected a putative larch ladybird (*Aphidecta obliterata*), found on heather, might have been a lightly marked hieroglyphic ladybird (*Coccinella hieroglyphica*). However, the recorder confirmed his original identification, and pointed out that there was substantial conifer plantation in close proximity to the location where the ladybird was found.

In some cases, an apparently bona fide report is so out of the ordinary, generally because a species has been found well outside its known distribution, or because an exceptionally large number of ladybirds is involved, that we feel a visit to the location is warranted. It is a testimony to the ability of our recorders, that, in every such case, the report received initially has been correct in every important detail.

The distribution maps are based on the 10–km square national grid system. We were aware that many of our potential recorders would not have experience in reading map references. We therefore gave details of how map references should be taken. In addition, a verbal description of geographical location was requested. In the majority of cases, records of ladybirds have included both types of location information. In all cases, the two are cross-checked for consistency. In the very small number of cases where the map reference given does not agree with the verbal location given, we have written to the recorders seeking further information to clarify the matter.

We must stress that in any case where there has been any doubt about the correct identity of a ladybird, or an accurate map reference, the record has been discarded and has not been placed on the distribution maps.

Ladybird distributions

Maps 1–23 give the known distributions of 23 british ladybirds. The 13-spot ladybird (*Hippodamia 13-punctata*) has not been recorded during our survey. All of the records represented on the maps are from observations made between 1.iv.84 and 31.xii.89, and received by the Cambridge Ladybird Survey by the latter date.

We are aware that none of the maps represents a complete picture of a species' present geographical distribution. There are biases due to the number of recorders living in different regions, and to the variation in the ability of recorders to find some of the smaller, more secretive, or more habitat-specific species. Undoubtedly many 10-km squares, particularly in areas where few people live, such as highland regions and some of the off-shore islands, have never been visited by our recorders. Despite these shortcomings, some conclusions can be drawn from the distribution maps, even at this stage. These are given below for each species, together with notes on suspected biases in the distribution maps, and reasons for these biases.

Subcoccinella 24-punctata L. (24-spot ladybird) Map 1. Widely distributed and often common in lowland parts of southern England, East Anglia, and south and west Wales. Scarce in the midlands and further north. A small species that will often be missed if not sought by examining low growing plants carefully by eye or with a sweepnet. Probably under-recorded in the midlands, Avon and around the Thames estuary.

Hippodamia 13-punctata L. (13-spot ladybird) No map. No records. Probably extinct. It is our belief that this species will again be recorded in Britain. The majority of past records of this species are from eastern counties (Majerus, in prep. a). We suspect that intermittently small numbers of this species, possibly including some gravid females, migrate to Britain from the continent. When they arrive, they establish colonies that persist for a period of a few years before dying out, probably because of the inclemancy of our climate. It is possible that as our climate changes due to the effects of atmospheric pollution ('the greenhouse effect') this species may become established as a permanent resident.

Adonia variegata Goeze (Adonis ladybird) Map 2. A scarce and local species, known to be well established in three regions (London and Surrey, southern Wales and Staffordshire), with a few other scattered records generally of only one or a few individuals. Absent from Scotland. Possibly under-recorded due to its local nature, however, there is no reason why it should have been recorded less than other species, such as the 11-spot ladybird (Map 10), which is similar in size and may be sought in the same way, unless it really is much more local and scarce.

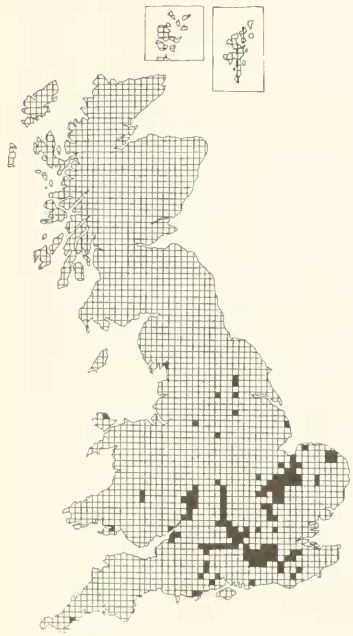
Anisosticta 19-punctata L. (water ladybird) Map 3. Widely distributed and often common (in appropriate habitats, ie reed beds) in southern, eastern and central England. Scarce in the west. Absent from Scotland. As this species is so habitat-specific, rarely being found away from reed-mace (*Typha*) or reed (*Phragmites*) beds, it will be missed unless such habitats are specifically examined. We suspect it is underrecorded in Essex, Kent, Suffolk and Hertfordshire, and the same may be true of other parts of south and central England.

Aphidecta obliterata (larch ladybird) Map 4. Widely distributed and often common or abundant in appropriate habitats (conifer woodland). Distribution of recorders bias in England and Wales. Probably very much more widespread in Scotland than shown.

Micraspis 16-punctata L. (16-spot ladybird) Map 5. Widely distributed and often common in southern and eastern England. Becoming rarer to the north and west. Scarce in Wales. Absent from Scotland. A small meadowland species which is easily missed unless sought by sweeping.

Map 1. 24 spot ladybird *Subcoccinella 24-puntata*

Map 2. Adonis' ladybird *Adonia variegata*



Map 3. Water ladybird *Anisosticta 19-punctata*

Map 4. Larch ladybird *Aphidecta obliterata*

Map 5. 16 spot ladybird *Micraspis 16-punctata*

Map 6. 2 spot ladybird *Adalia 2-punctata*

Map 7. 10 spot ladybird *Adalia 10-punctata*

Map 8. 7 spot ladybird *Coccinella 7-punctata*

Map 9. 5 spot ladybird *Coccinella 5-punctata*

Map 10. 11 spot ladybird *Coccinella 11-punctata*

Map 11. Scarce 7 spot ladybird *Coccinella magnifica*

Map 12. Hieroglyphic ladybird *Coccinella hieroglyphica*

Map 13. Cream-streaked ladybird *Harmonia 4-punctata*

Map 14. Orange ladybird *Halyzia 16-guttata*

Map 15. 18 spot ladybird *Myrrha 18-guttata*

Map 16. 22 spot ladybird *Psyllobora 22-punctata*

Map 17. Cream-spot ladybird *Calvia 14-guttata*

Map 18. 14 spot ladybird *Propylea 14-punctata*

Map 19. Striped ladybird *Myzia oblongoguttata*

Map 20. Eyed ladybird *Anatis ocellata*

Map 21. Kidney-spot ladybird *Chilocorus renipulstulatus*

Map 22. Heather ladybird *Chilocorus 2-pustulatus*

Map 23. Pine ladybird *Exochomus 4-pustulatus*

Adalia 2-punctata L. (2-spot ladybird) Map 6. Widespread and often abundant, except at high altitude. Some distribution of recorders bias.

Adalia 10-punctata L. (10-spot ladybird) Map 7. Widespread and often abundant, except possibly at high altitude. Some distribution of recorders bias.

Coccinella 7-punctata L. (7-spot ladybird) Map 8. Widespread and abundant. Some distribution of recorders bias. NOTE: This map may be useful as a bench-mark of distribution of recorders bias, for we suspect the 7-spot ladybird occurs in virtually every 10-km square in Britain. Consequently, large gaps in the distribution map for this species may be taken as an indication of areas where we have few, or no, regular recorders.

Coccinella 5-punctata L. (5-spot ladybird) Map 9. Rare with a markedly disjunct distribution. Well established in suitable habitats in west Wales. Otherwise, also established in the Spey Valley in Scotland. The record in the midlands has been verified and probably represents a vagrant (Majerus, in press, a). The status of the Cornish record (a single individual) is not known. Due to the specialized nature of its preferred habit (unstable river shingles) (see Majerus & Fowles, 1989) appropriate sites for this species in Britain are often inaccessible. It is possible that the species occurs in other places where such habitats occur, particularly in western England and in Scotland.

Coccinella 11-punctata L. (11-spot ladybird) Map 10. Widely distributed and sometimes common, particularly on, or near, coasts. Strong distribution of recorders bias in inland areas.

Coccinella magnifica Redt. (scarce 7-spot ladybird) Map 11. Principally found in the south-east of England with a small number of records from further north. Generally very local, but not uncommon where it occurs. Due to its similarity to the 7-spot ladybird this species may be frequently overlooked. Further, because it often occurs in very small localized areas around nests of the wood ant, *Formica rufa* L., the number of 10-km squares where it occurs may be greatly underestimated (Majerus, 1989).

Coccinella hieroglyphica L. (hieroglyphic ladybird) Map 12. A disjunct distribution which follows areas where large expanses of *Calluna* and *Erica* heatherland occur. Population sizes vary greatly from year to year. Probably greatly under-recorded in Scotland, central Wales, and possibly the Pennines. It is best sought by sweeping heather.

Harmonia 4-punctata Pont. (cream-streaked ladybird) Map 13. Widely distributed in south-east England and East Anglia where conifers occur. Becoming scarcer and rather local to the north and west. Rather scarce in Wales and very rare in Scotland. An immigrant species which is still spreading from its original immigration point in East Anglia (see Hammond, 1974). May be as yet undetected in many areas on the edge of its range which we suspect will continue to expand to the north and west.

Halyzia 16-guttata L. (orange ladybird) Map 14. Widespread and sometimes common, particularly in southern England and west Wales. The species was once thought to be an indicator of relict ancient deciduous woodland, and rather scarce. However, since it was discovered, in 1987, to have a strong preference for sycamore (see Majerus & Williams, 1989), the number of records of this species has increased dramatically. We suspect the species is still severely under-recorded, but expect this situation to improve over the next 5 years, now that its preferred host tree is known.

Myrrha 18-guttata L. (18-spot ladybird) Map 15. Widespread and not uncommon in southern England, East Anglia and west Wales. Its distribution elsewhere is uncertain. We suspect that there is a very strong collector bias in respect of this species. A Scots pine specialist, this species is very difficult to find by eye, due to its

semi-cryptic markings. It must therefore be beaten for. Its preference for living in the crowns of old mature Scots pines also makes it difficult to find (see Majerus, 1988). The fact that over 90% of our records for this species have come from our own research team in Cambridge, or from other experienced entomologists, is perhaps an indication that some experience is needed in finding this ladybird. We suspect that it occurs in appropriate areas over much of England and Wales. We would not wish to guess at its status in Scotland.

Psyllobora 22-punctata L. (22-spot ladybird) Map 16. Widespread and sometimes common in south and central England and in Wales. Becoming rarer to the north with few records from Scotland. Some distribution of recorders bias.

Calvia 14-guttata L. (cream-spot ladybird) Map 17. Generally distributed over the British Isles. Some distribution of recorders bias.

Propylea 14-punctata L. (14-spot ladybird) Map 18. Generally distributed and often common over England, Wales and southern Scotland. Rare or absent in the Highlands and north-west of Scotland. Some distribution of recorders bias. We suspect it is severely under recorded in the midlands and the north of England.

Myzia oblongoguttata L. (striped ladybird) Map 19. Widely distributed across Britain where its preferred habitat occurs (mature Scots pine). Probably under-recorded in many parts of the country, and in particular in central Wales, the Lake District, and in pine plantations in the north of England and Scotland.

Anatis ocellata L. (eyed ladybird) Map 20. Widely distributed and often common in appropriate habitats (Scots pine) across Britain. Some distribution of recorders bias.

Chilocorus renipustulatus Rossi (kidney-spot ladybird) Map 21. Widely distributed and locally abundant in south and central England, becoming scarce in Wales and northern England. Absent from Scotland. Strong distribution of recorders bias in southern England.

Chilocorus 2-pustulatus L. (heather ladybird) Map 22. Disjunct distribution in England, where it is found principally on extensive areas of heather moorland and heathland. Scarce in Wales. Absent from Scotland. Probably severely under-recorded in Wales, and possibly on the moorlands of Yorkshire, the Pennines and the Lake District. Most easily found by sweeping heather.

Exochomus 4-pustulatus L. (pine ladybird) Map 23. Generally distributed and sometimes abundant in southern England, East Anglia and Wales. Becoming scarcer to the north. Rare in Scotland. Some distribution of recorders bias in the southern half of Britain.

Criticisms of the survey and its future

The above notes indicate that for many species the precise distributions depend crucially on habitat or host plant preferences. From notes sent in by recorders, and from our own observations we have compiled an extensive dossier on these preferences. This will be the subject of a separate paper (Majerus, in press, b).

The Cambridge Ladybird Survey is to continue until September 1994. It is perhaps pertinent to note that the survey has been criticized on two points. Firstly, data provided by inexperienced recorders is likely to be unreliable. Secondly, that no attempt was made to obtain an even spread of recorders with equal time available and of equal ability so that biases in distributions would be inevitable.

We accept the latter criticism, and have recently made attempts to increase the number of recorders we have in some of the less well covered areas. So, for example, in a recent interview with Charles Kennedy on BBC Radio Scotland we appealed for

help from interested persons, particularly those living in the Highlands and Southern Uplands. Further, we have written articles about the survey for various natural history societies, the most recent being one for the *North-West Naturalist*, which will hopefully attract more recorders from the Lake District and adjacent parts of the North-West of England. Approaches are also being made to wardens of nature and bird reserves on off-shore islands, and we are attempting now to include Ireland in the survey.

With regard to the first criticism, that data provided by inexperienced recorders is likely to be unreliable, we understand the criticism, but feel that the rewards that have accrued from encouraging all and sundry to take part, far outweigh the possibility that some data might be incorrect. We have already described the ways in which we have attempted to ensure data integrity, and we believe that the vast majority of the five and a half million records are bona fide. In addition, it is perhaps worth pointing out some of the pluses that have resulted from opening the survey to all comers. Firstly, the number of experienced recorders we have would be considerably less if we had tried to restrict the survey to experienced biologists or entomologists. Most of our recorders have heard of our work from our appearances on television, radio and in the national and local press. We feel it highly unlikely that the media would have been so willing to cover and publicize the survey if those invited to take part in it had to have relevant experience. For example, we do not believe that programs such as 'Saturday Superstore', 'The Wide Awake Club', 'John Craven's Newsround', 'Bellamy's Bugle', 'Wild Track', 'Caterpillar Trail', 'The BBC 1 9 O'clock News' or Radio 4's 'Today Programme' would have given us air time if a biology degree or membership of an entomological society had been a necessary qualification to take part in the survey.

Secondly, we felt that the subjects of the survey and the nature of the material we were seeking did not necessitate any great level of experience amongst recorders. Indeed, the survey was tailored to less experienced recorders almost from its conception, as evidenced by the fact that we restricted it to the 24 larger, more easily identified British coccinellids, and that we invented English names for those species previously lacking them so that younger recorders did not have to try to cope with latin binomials.

Thirdly, by including inexperienced recorders who had no preconceived notions of where to look and which types of habitats or which species of plant to search for ladybirds, we have gained a great deal of information which might have eluded experienced entomologists who did 'know' where to look. To give one spectacular example, in 1987 a young girl found orange ladybirds on sycamore, a tree which entomologists 'know' has a relatively poor insect flora. The follow-up to the initial record led to the confirmation that this tree is the most usual host-plant of this ladybird. Subsequently we found the early stages of the species for the first time, and the ensuing dissemination of this information to our recorders has led to a tremendous increase in reports of this ladybird during 1988 and 1989.

Finally, we feel that the involvement in the survey of many people who had little or no formal biological training, has shown that at least some science can be made accessible to a wide audience. The publication of this and a series of other papers on the results of the first 5 years of the survey will hopefully show that anyone can become involved and make valuable and novel contributions. If involvement in the survey has also made some people more sympathetic to ladybirds in the first instance, and the natural flora and fauna in the second, this in itself may be the most valuable result of the survey.

As this paper shows, there is still a need for ladybird records from anywhere in

Britain, but particularly from some of the less well populated regions. We would be pleased to hear from anyone who might be able to help to increase our knowledge of this attractive group.

Acknowledgements

I wish to acknowledge with thanks, all the recorders of the Cambridge Ladybird Survey. This paper is a testimony to their endeavours. Heather Ireland contributed greatly to the growth and success of the survey in its early years. Drs Peter Kearns and Peter O'Donald have also give valuable assistance. I would also like to thank Joanne Griffiths for typing the manuscript, and Tamsin Harris for editing and correcting it.

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SHORT COMMUNICATIONS

***Ptinus subpilosus* Sturm (Coleoptera:Ptinidae) rediscovered in Gloucestershire.**— It is many years now since *Ptinus subpilosus* was last seen in Gloucestershire. The only records in Atty (1983) are from the Forest of Dean area in the western Vice-County: Dean, 1880, A.E. Hodgson; Speech House and Newnham, E.W. Morse (pre-1900). Atty (pers. comm.) knows of no more recent records.

Two specimens were found beneath loose webby bark on an ancient oak pollard in Rendcomb Park (SP 0110), E. Glos., in company with larvae of *Ctesias serra* (F.) on 17.iv.90. Rendcomb is an old deer park, in existence by the 16th century, and has a large number of such oaks. It is already known to have an interesting deadwood fauna, from the records of I.S. Menzies, E.G. Neal and H.K. Airy Shaw in the 1940s (detailed in Atty, 1983). A visit by the Gloucestershire Invertebrate Group in 1988, organized by I.S. Carter, found species such as *Platyrhinus resinosus* (Scop.) and, in the adjoining Clifferdine Wood, *Selatosomus bipustulatus* (L.). The latter had been found in the Park previously by Menzies, in 1946.